June 16, 2003

TO: Internal File

THRU: Peter H. Hess, Sr. Reclamation Specialist/Engineer, Team Lead

FROM: Priscilla W. Burton, Sr. Reclamation Specialist/Soils

RE: Division Order, West Ridge Resources, Inc., West Ridge Mine, C/007/041-DO00A-7

SUMMARY:

Construction of the portal at the West Ridge Mine did not go according to plan when burned coal was encountered. The extensive highwall was not contemplated in the Mining and Reclamation Plan and the Division requested a modification to the reclamation plan.

The chronology of the Division Order is as follows:

Division Order		April 6, 2000
Initial Submittal	July 14, 2000	
Follow-up information	September 18, 2000	
Division Response		November 30, 2000
West Ridge Resources, Inc response	March 16, 2000	
Follow-up information	July 2 & 14, 2001	
Division Response		September 21, 2001
Follow-up information	January 15, 2002	
Division Response		April 12, 2002
Follow-up information	August 15, 2002	
Division Response		October 10, 2002
West Ridge Resources, Inc response	March 17, 2003	
This Technical Analysis		June 13, 2003

The Permittee has provided the Division with two scenarios for backfilling the highwall. The scenario preferred by the Permittee is outlined in Appendix 5-9 by Agapito Associates. Appendix 5-9 describes a highly engineered fill with a vertical angle slope of 40 degrees (more than 1.5h:1v). The scenario involves a rock toe, three different geotextile applications, six-inch lifts, nuclear density testing, and a P.E. on site during construction.

The alternative, as described in Appendix 5-10 by Blackhawk Engineering, is to create a slope that is about 31.2 to 33.6 degrees (approximately 2.5h:1v), extending the toe of the slope to the northwest into the existing experimental practice topsoil storage location, requiring a 40 foot lateral displacement of the reclaimed stream channel for a distance of 450 feet.

The backfill to be used in either scenario is high in EC (6.4) and SAR (8.2), but this is categorized as FAIR material according to the 1988 Division Guidelines for Management of Topsoil and Overburden. The reclamation plan presented for the 40-degree slope includes the replacement of one foot of topsoil, an organic amendment (Biosol), gouging, seeding, and mulching shrub and tree transplants.

TECHNICAL ANALYSIS:

GENERAL CONTENTS

REPORTING OF TECHNICAL DATA

Regulatory Reference: 30 CFR 777.13; R645-301-130.

Analysis:

The Appendix 5-9 reclamation plan is based upon a report jointly produced by Agapito Associates, Inc. (AAI) and Mt. Nebo Scientific, entitled, “Stability Evaluation for the Proposed Reclaimed Slope at the Portal Excavation, West Ridge Mine, March 13, 2003, Revision No. 4.” AAI was responsible for slope stability and geotechnical design.

AAI sampled the existing and proposed slope materials, designed a laboratory-testing program, analyzed the test results, and developed the geotechnical slope stability model and design. Appendix 5-9 has the stamp of a professional engineer, Francis S. Kendorski, Principal and Vice-President of Agapito Associates Inc.

Geotechnical soil analysis was conducted (January 2003) by Advanced Terra Testing, Inc., 833 Parfet Street, Lakewood, Colorado (303) 232-8308. The Advanced Terra Testing information is included as Appendix A of the AAI report.

The chemical characteristics of the topsoil and backfill (subsoil) material were evaluated by Colorado Analytical laboratories, Inc., 240 South Main Street, Brighton, CO 80601 (303-659-2313) and are reported in Appendix A of Appendix 5-9.

Mt. Nebo Scientific supplied the revegetation and erosion control methods. The three consultants have been listed by names and addresses in Appendix 1-6.

The reclamation plan in Appendix 5-10 was produced by Blackhawk Engineering, Mr. Dan Guy, Professional Engineer.

Findings:

The information meets the requirements for reporting of technical data.

ENVIRONMENTAL RESOURCE INFORMATION

Regulatory Reference: Pub. L 95-87 Sections 507(b), 508(a), and 516(b); 30 CFR 783., et. al.

ILS RESOURCE INFORMATION

Regulatory Reference: 30 CFR 783.21; 30 CFR 817.22; 30 CFR 817.200(c); 30 CFR 823; R645-301-220; R645-301-411.

Analysis:

Soils in the vicinity of the highwall are listed on Map 2-2 as Midfork, very stony fine sandy loam, 10 – 50% slopes. Prior to disturbance, these soils were described in Appendix 2-2. Pit 14 was located in the immediate area of the highwall. In his January 15, 1997 Soil Resource Assessment, Mr. James Nyenhuis described the soils on the slopes of the highwall thusly:

It (the Midfork map unit) *is located primarily along the more densely vegetated south slope (north-facing slope) of the right fork drainage. Present vegetation is mainly Douglas-fir and snowberry. The average annual precipitation is 16 to 20 inches, and the average freeze-free period is 60 to 80 days.*

The M map unit is 75% Midfork, and 10% Rubbleland, 10% Commodore, and 5% Rock Outcrop. Midfork is deep to very deep, well drained. Effective rooting depth is 60 inches or more. Commodore is similar to Midfork but is shallow (<20 inches) to bedrock. Commodore was not sampled because it is a minor inclusion. Typically, the surface of Midfork is covered by an organic layer of twigs, leaves, and needles about 1.5 inches thick. The very dark grayish brown to brown "A" horizon is 5 – 7 inches thick and has gravelly to very stony fine sandy loam-to-loam texture. Total rock fragment content of the "A" horizon ranges from about 17 – 35% and can include about 10% gravel, 5 to 10% cobble or flagstone, and 2 – 15% stones and boulders.

The underlying subsoil layer is typically from about 7 to 18 inches in depth, and has very cobbly sandy loam-to-loam texture. Total rock fragment content of the subsoil ranges from about 7 to 40% and can include 5 to 15% gravel, 5 to 15% cobble or flagstone, and 1 to 15% stones and boulders. The substratum extends from the subsoil to a depth of 60 inches or more and has very gravelly to very stony sandy loam-to-loam texture. Total rock fragment content of the substratum ranges from about 35 to 40% and can include 10 to 15% gravel, 10 to 15% cobble or flagstone, and 10 to 20% stones or boulders. (Appendix 2-2, pp 14 - 15).

Soils from the highwall slope were salvaged to a depth of 18 inches. Mr. Nyenhuis indicated that below this depth, the rock fragment content exceeded 35 – 40% and 20% of that was large stones and boulders (Appendix 2-2, page 15).

Findings:

The information provided in the MRP adequately describes the pre-existing condition of the highwall.

OPERATION PLAN

TOPSOIL AND SUBSOIL

Regulatory Reference: 30 CFR Sec. 817.22; R645-301-230.

Analysis:

Removal and Storage

This submittal revises page 30 of Appendix 5-5 to indicate that there is no topsoil storage area in the left fork (ASCA Y has been eliminated). The area is dedicated to coal storage. Map 2-2, Mine site Order 1 Soil Survey has been revised accordingly. Sample site locations have been retained on Map 2-2. (The commitment to sample the soil of the operations pad over the next five years is described in the Annual Report year 2000.)

Revised Map 2-4, Topsoil Storage Area provides cross-sections and a profile of the topsoil stockpile, indicating that **7,613 cu yards of soil are presently stored** in the topsoil storage area. In response to the deficiency written on October 10, 2002, Appendix 5-9 (page 3) indicates that the source of topsoil for the highwall reclamation will be from this topsoil stockpile. The highwall area is roughly triangular in shape, with a base of 300 ft and a height of 85 ft (page 3, App 5-9). The Division estimates the area of the reclaimed highwall site would therefore be no less than 12,750 sq ft or one third of an acre and would require approximately 500 cu yds of topsoil at a twelve-inch replacement depth.

Topsoil Substitutes and Supplements

Borrow area soils have been identified on page 2-14 of the MRP and in Appendix 2-4. Map 2-4 locates the borrow soils and provides reclamation contours for the borrow site. The plan does not directly indicate that these soils will be used for topsoil.

Findings:

The information supplied does not meet the requirements of Reclamation Plan, Backfilling and Grading. Prior to approval, the Permittee must provide the following:

R645-301-241, The plan should indicate the approximate area of the highwall reclamation site and the required topsoil volume to achieve a twelve to eighteen inch topsoil replacement depth.

RECLAMATION PLAN

BACKFILLING AND GRADING

Regulatory Reference: 30 CFR Sec. 785.15, 817.102, 817.107; R645-301-234, -301-537, -301-552, -301-553, -302-230, -302-231, -302-232, -302-233.

Analysis:

Backfilling and Grading On Steep Slopes

Two reclamation scenarios have been proposed: a 40 degree slope as described in Appendix 5-9 or an alternative of 31.2 to 33.6 degrees as described in Appendix 5-10. In either scenario, the backfill will be excavated from the warehouse and portal pad (page 3, App 5-9 and Section III of Appendix 5-10).

The backfill material has a USCS classification of GM (silty gravel with sand). The material is approximately 50% gravel, 25% sand, 25% fines, (App 5-9, App A, Physical Properties Tests Backfill). Table 2, Section 3.3 of Appendix 5-9 reports the backfill to have a plasticity index of 6.5, a saturated weight of 138 pcf, a moist cohesion of 1,877 psf and internal angle of friction of 54° based upon the Advanced Terra Testing (2003) study. [**Note: These figures are significantly different than the information previously presented for the backfill. Appendix 5-9 Revisions No. 2 (received August 15, 2002) and No. 3 (Received January 15, 2002) report the backfill to have a plasticity index of 6.5, a saturated weight of 121.6 pcf, a moist cohesion of 771.7 psf and internal angle of friction of 38.4 degrees based upon the Advanced Terra Testing (2002) study.]

The stress/strain graph for the backfill material is shown in Appendix A of Appendix 5-9. (The graph is mistakenly labeled "Displacement vs. Shear Stress **Topsoil**," rather than "**Backfill**." However, the information on the graph correlates to that reported by the laboratory for the backfill. The graph indicates that there is no peak shear, but that the material is displaced steadily as force is increased.

A post-peak internal angle of friction (Phi) was derived from the point on the stress/strain curve representing the maximum stress applied during testing. By way of explanation of the term post-peak friction angle, Agapito Associates Inc indicates that the coarse-grained material chosen for the backfill "continued to gain strength after shearing had begun. This was probably because the larger particles in the material were rotating, causing the larger particles to act as keys and increase shearing resistance." AAI also states, "Post-peak shear strengths are typically used in slope evaluation because the conservative assumption is made that the material has already undergone peak shearing." (App5-9, Section 3.3.4, page 10).

Since the material rotates under confined conditions, this situation presents a question for reviewers. Will the material within the fill begin to rotate under strain and create movement in its unconfined placement on the slope?

The reported value of 54 degrees for Phi (Internal Friction Angle) describes a very strong material with high resistance to shearing. The very high Cohesion of 1,877 psf describes a material that one would suspect is very plastic. This material was described as non-plastic (App 5-9, Appendix A, Atterberg Limits tests Backfill). Consequently, the opinions of recognized geotechnical experts were sought by the Division on the Atterberg Limits, Mohr Colomb and Proctor Tests of the backfill material.

Dr. David J. Elton, P.E. of Civil Engineering Department at Auburn University had the following comments:

"54 degrees is possible, …the curves don't peak – I don't know why they refer to them as peak strengths…for NP fines, 2000 psf cohesion is very suspect…I don't understand their spreadsheet data reduction that lists phi for every displacement. How can they tell what

phi is? You have to run at least two tests, and plot, etc. The data is consistent, anyway. I wonder if the data was reduced correctly."

Tuncer B. Edil, Professor & Chair Geological Engineering Program and Professor of Civil & Environmental Engineering at the University of Wisconsin-Madison had the following comments:

"From your description I see no peak to speak of post-peak. You describe a near-linearly rising curve and use of end-point stresses in calculating strength. Is this being performed in a direct shear device? What is the maximum size of the gravel grains and the size of direct shear box? I find 54 degrees very high and suspect. Combined with that unusually high cohesion, this material becomes one of the strongest anywhere. The argument about post-peak being conservative etc is correct and fine but I am not sure that is what you have here. There may be a test artifact…."

Laboratory information indicates that the backfill was sampled at five locations (App 5-9, App A). These samples were then composited for a direct shear test that was run at three applied stress levels. Given the extreme values reported by this single test and the deviation from the previous information known about the backfill, the Division requests that at least two more direct shear tests are run on the sample to provide an average value for the Mohr-Coulomb strength criteria for the material. This information is necessary regardless of which reclamation scenario is employed, since both Appendix 5-9 and Appendix 5-10 rely on the same geotechnical information for stability calculations.

Findings:

The information supplied does not meet the requirements of Reclamation Plan, Backfilling and Grading. Prior to approval, the Permittee must provide the following:

R645-301-553.130, Regardless of the reclamation scenario chosen (appendix 5-9 or appendix 5-10), the application should include the results of multiple tests of the composited backfill samples for Mohr-Coulomb stress criteria to verify the extreme values reported.

TOPSOIL AND BSOIL

Regulatory Reference: 30 CFR Sec. 817.22; R645-301-240.

Analysis:

Redistribution

Two reclamation scenarios (Appendix 5-9 and 5-10) have been presented in this application. Regardless of which reclamation scenario is employed, the same topsoil and backfill will be used. The chemical characteristics of the topsoil and backfill (subsoil) material were evaluated by Colorado Analytical laboratories, Inc., 240 South Main Street, Brighton, CO 80601 (303-659-2313) and are reported in Appendix A of Appendix 5-9. A composite sample of the backfill was found to have sandy loam texture (56% sand, 30% silt, 14% clay); pH 7.8; **EC = 6.84**; **19.2% $CaCO_3$**; 24.3 %Saturation; **K factor of 0.32** and **SAR of 8.2**. A composite sample of the topsoil was found to have a loam texture (44% sand, 36% silt, 20% clay); pH 7.8; **EC = 0.68**; **3.3% $CaCO_3$**; 37.7% saturation; **K factor of 0.38** and **SAR of 0.8** (by Division calculations SAR = 0.74). Selenium and boron levels were within the acceptable range.

The following information pertains to the redistribution of substitute topsoil under the scenario proposed in Appendix 5-9:

- The rooting zone backfill will be placed in 1.5 ft. lifts three feet wide adjacent to the compacted backfill lifts as the slope is constructed. A 1.5 ft lift of topsoil will be laid down one foot wide adjacent to the backfill as the slope is constructed (Section 6.0, pg 21).
- Geogrid (Tensar BX1100) will be in the fill at 1.5 ft depth intervals to add strength to the topsoil and uncompacted fill layers (Section 6.0, pg 22).
- The slope will be roughened to a depth of 12 – 18 inches (Section 4.1, page 13) or as described by the Division's 2001 publication, <u>The Practical Guide to Reclamation</u> (Section 6.0, page 22).
- Boulders will be placed on the slope with an excavator (Section 6.0, pg 22).
- An application of slow release 6-3-1 Biosol fertilizer at 1500 lbs/ac (Section 4.2, pg 14).

The scenario described above (Appendix 5-9) will not likely be implemented as described for the following reasons:

(1) Pocking as described in Appendix 5.9 cannot be achieved due to the geogrid installations every 1.5 feet.

(2) Use of the geogrid every 1.5 feet in depth will limit the depth of the planting hole for the 5-6 ft trees described in Section 6.0 page 22.

Soil redistribution plan for the reclamation described in Appendix 5-10 will be the same as that described for other cut slopes on the site (Section II, App 5-10). This reclamation sequence is described in Appendix 5-5, Part II and on Map 5-12 of the approved Mining and Reclamation Plan (MRP). Key reclamation tasks are summarized in Section 3 and detailed in Section 4 as follows:

4a) Remove Surface Structures
4b) Remove Pad Cap Layer
4c) Remove Excess Pad Fill
4d) Remove Remaining Pad Fill; Backfill All Cut Slopes
4e) Reclaim Portal Highwall
4f) Reapply Topsoil to Backfilled Cut Slopes
4g) Re-expose and Revitalize the Left-in-Place Topsoil
4f) Re-establish the Original Rubbleland Surface

The approved MRP indicates in Appendix 5-5 Section 4e that backfilling and grading of the highwall will not take place until the excess fill has been removed. The Permittee should re-evaluate the potential for excess fill under the two reclamation scenarios and revise the plan accordingly in Appendix 5-5 Section 4e.

The MRP describes the importation of fill material from the gravel pit and replacement of the fill to the gravel pit at final reclamation (Appendix 2-5 and Addendums). Map 5-11 Construction Sequence, illustrates the different stages of construction for the West Ridge Mine site. Steps 7 shows completion of the pad level by hauling in imported fill from offsite, commercial gravel borrow areas. Step 8 shows a final cap layer of road base material placed over the imported fill surface. Apparently, the imported fill was not needed, because the Permittee has recently stated that imported bedding material was used around the culvert only, with the rest of the fill generated from the cuts and a surface layer applied from the gravel pit (Division communication with Mr. Gary Gray and Mr. Dave Shaver on April 29, 2003).

Findings:

The information supplied does not meet the requirements of Reclamation Plan, Topsoil Subsoil. Prior to approval, the Permittee must provide the following:

R645-301-242.120, Pocking and planting of trees as described in Appendix 5.9 will not likely be achieved due to the geogrid installation every 1.5 feet. A more realistic statement of pocking depth and tree planting should be described for Appendix 5.9.

R645-301-553, The Permittee should re-evaluate the potential for excess fill under the two reclamation scenarios and revise the plan accordingly in Appendix 5-5 Section 4e and Appendix 2-5.

STABILIZATION OF SURFACE AREAS

Regulatory Reference: 30 CFR Sec. 817.95; R645-301-244.

Analysis:

The approved MRP utilizes boulders (Appendix 5-5, Section 4e) and scarification 6 – 12 inches (Section R645-301-542.200, page 5-49) and extreme gouging with dimensions approximately 24" x 36" x 18" deep (Section R645-301-341, page 3-11). These measures will remain unchanged with the implementation of Appendix 5-10.

Figure 5 of the Agapito Associates report Revision No. 4 in Appendix 5-9 illustrates the additional stability components required for the 40-degree reclaimed slope. They include a geosynthetic composite drain, rock toe drain, geotextile filter fabric, and geogrid reinforced slope. The surface boulders and surface roughening to a depth of 12 – 18 inches will also be employed (Section 4.1, page 13).

Figure 6 of Appendix 5-9 describes the following additional measures for stability:

- Boulders (1 per 100 sq ft) will be used to add additional surface roughening and erosion protection (Fig 6, Appendix 5-9).
- The mix described in Table 5 of the AAI report will be hydro-seeded (Section 4.2, pg15).
- The seeded slope will be mulched at a rate of 3500 lbs/ac with a bonded fiber matrix such as EcoAegis or SoilGuard (Section 4.2, pg 14).
- Diverter logs may be used parallel to the contour (Section 4.2, pg 16).
- Containerized shrub and 5-6 ft. trees will be hand planted (Section 6.0, pg 22).

Findings:

The information provided meets the requirements of the regulations for applying the best technology available to stabilize surface areas.

EXPERIMENTAL PRACTICES NING

Regulatory Reference: 30 CFR Sec. 785.13; R645-302-210, -302-211, -302-212, -302-213, -302-214, -302-215, -302-216, -302-217, -302-218.

Analysis:

Appendix 2-6, West Ridge Mine Experimental Practice In-Place Topsoil Protection, details protecting topsoil resources in-place for (1) buried topsoil areas, and (2) buried RO/RL (rock outcrop/rubbleland) Travessilla Complex soil area. These two combined areas account for 16.75 acres of the total 29 acres of disturbed area.

(1) Buried Topsoil Areas

The West Ridge Resources topsoil protection protects in-place soil with a layer of geotextile fabric. The geotextile fabric provides a protective barrier between the existing soils and the imported fill materials used to construct the mine pads. By utilizing this procedure, soils were not only preserved in-place, but the existing stream channel geomorphology and original ground surface configuration were also preserved. Approximately 4.75 acres of the proposed 29-acre disturbed area were preserved using the geotextile fabric.

(2) Buried RO/RL Travessilla Complex Areas

The buried RO/RL Travessilla Complex mapping was also included in the Experimental Practices. As stated in the Order-III soil survey, the RO/RL Travessilla Complex unit contains 35% soils by volume (25% Travessilla plus 10% other soils) that supports a significant vegetation community. As stated in the plan, the RO/RL areas were not covered with geotextile, but instead, fill was placed directly over the existing ground surface which was marked with brightly colored marker flagging strips placed on 8-foot centers for the purpose of identifying the original surface during reclamation and excavation of the pad fills. Marker strips were used on approximately 12 of the 29 acres of the disturbed area.

Implementation the 40-degree slope described in Appendix 5-9 would not affect the Experimental Practice as the driving factor in the design was keeping the toe of the slope at the lower bench in to protect the In-Place Topsoil.

The Permittee was asked (Technical Analyses dated April 12 and November 26, 2002) to demonstrate to the Division that restoration of the highwall to a 40-degree slope and retention of the experimental practice would result in a site that was at least as environmentally sound as the alternative of eliminating a portion of the experimental practice and reducing the slope of the backfill.

A reclamation design for a 31.2 to 33.6 degree slope has been presented in Appendix 5-10. This slope would affect the experimental practice between cross sections 24+00 and 27+00 shown on Map 5-9. The area of buried topsoil to be affected would be 400 ft x 80 ft or approximately 0.74 acres. By Division calculations this represents 15.5% of the buried topsoil portion of the experimental practice and 0.04% of the entire experimental practice area that includes both buried salvageable topsoil and buried Rockoutcrop/Rubbleland Travessilla complex. There would be no additional disturbance to the south-facing slope of the right fork of C Canyon according to the cross sections shown in Map 2 of Appendix 10.

The Division is of the opinion that the successful revegetation of the site takes precedence over the experimental practice. If necessary to achieve a stable and revegetated site, the experimental practice area could be reduced in size. The significance of the alteration to the experimental practice was determined based upon the affect to the in-place topsoil, but no consideration was given to the affect on the buried RO/RL Travesilla Complex areas of the experimental practice. These areas comprise 12 acres, but are not indicated on Map 2-2.

Findings:

The Division is required to make a Finding whether the continued existence of the experimental practice is environmentally sound. The information provided is not adequate to make that finding and further information has been requested under the hydrology section of this Technical Analysis. In addition, prior to approval, the Permittee must provide the following in accordance with:

R645-302-218, (1) The acreage of Buried RO/RL Travessilla Complex Areas to be affected by the implementation of Appendix 5-10 should be indicated such that the Division may determine the significance of the alteration to the experimental practice.

RECOMMENDATIONS:

The Permittee has provided the Division with two scenarios for backfilling the highwall. Appendix 5-9 is a very sophisticated design that would require rigorous attention to detail to implement. Appendix 5-10 presents an alternative (albeit with sketchy details) that should be preferred by the Division because:

- The stability of the slope can be assured without the use of drains, geosynthetics and geotextiles.
- The area of experimental practice to be affected is 0.74 acres.
- The remaining 16.01 acres of experimental practice would remain unaffected.
- The Division calculates that 0.04% of the 16.75 acres dedicated to the entire experimental practice and 15.5% of the acreage dedicated to buried topsoil will be affected by implementation of Appendix 5-10.

More detailed plans for the implementation of Appendix 5-10 should be requested.